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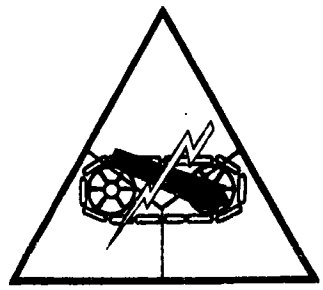
AUTHORITY

USAMRL ltr, 26 Feb 1970



ARMORED MEDICAL RESEARCH LABORATORY

FORT KNOX, KENTUCKY

PROJECT NO. 11 - Test of Clothing, Battle, Four-Zone, (OQMG-214), Cold and Arctic Zone Issues.

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ARMORED MEDICAL RESEARCH LABORATORY
Fort Knox, Kentucky

Project No. 11
724-1 GNOML

30 Sept 1943.

1. PROJECT: No. 11 - Test of Clothing, Battle, Four-Zone (OQMG-214), Cold and Arctic Zone Issues.

a. Authority - See Appendix A.

b. Purpose - To test the adequacy of the cold and arctic zone portions of the new four-zone battle clothing for its protective value against cold and to study the outfits in accordance with the outline of Test Data Sheet No. OQMG-214.

2. DISCUSSION:

In contrast to the freedom of ground troops in the cold to move about and thus warm themselves, men riding in vehicles, and especially in tanks, are obliged to remain relatively inactive for protracted periods of time. Thus, they do not have the opportunity to increase body heat sufficiently to compensate for that inevitably lost through clothing. Furthermore, contact with the metal surfaces of high conductivity undoubtedly increases the rate of heat loss through clothing. The constant air movement in moving vehicles, often of appreciable velocity, may also augment through convection the rate of heat loss. With these special conditions in mind, in the cold room tests of the new four-zone cold and arctic zone clothing the behavior of the clothing was studied with the subjects seated in an M5 light tank ventilated at a rate comparable to that provided when the tank is in operation, as well as under normal conditions of exposure in the test chamber.

Replies to specific queries accompanying test data sheet OQMG-214 are given in Appendix C. In Appendix D may be found a statement of the techniques used with a discussion of certain theoretical considerations. The observations on the protective value of the clothing are reported in detail in Appendix E.

3. CONCLUSIONS:

a. The cold zone issue, with correction of certain minor defects, will protect seated tank crews from excessive cooling for approximately two to three (2 to 3) hours at air temperatures down to $0^{\circ}F$, and with air movement through the crew compartment approximately equivalent to that encountered in a buttoned-up M5 light tank operating at a speed of 13 mph. It will safely protect them from freezing for somewhat longer periods.

b. The arctic zone issue will maintain Armored Command Tank crews in reasonable comfort for approximately two (2) hours at air temperatures down to -20°F, and with air movement through the crew compartment, equivalent to that encountered in a buttoned-up M5 light tank operating at a speed of 13 mph.

c. At -40°F the protection afforded by the arctic issue in this test was for one half (1/2) to one and a quarter (1-1/4) hours, with wind conditions similar to those at -20°F.

d. Both clothing issues failed to provide protection for longer periods because of excessive chilling of the hands and feet rather than of the body generally.

e. The chamois face mask is ineffective and even dangerous to wear because of the ease with which it becomes wet.

f. The cut of the parkas makes it difficult to open the clothing to increase cooling during work.

4. RECOMMENDATIONS:

a. That the cold and arctic zone issues of Clothing, Battle, Four-zone be considered for adoption by the Armored Command in preference to the Outfit, Combat, Winter.

b. That investigations be continued with a view to improvement of protection for the extremities by foot gear and gloves of improved design.

c. That, if possible, clothing for the trunk be designed to provide for greater ease of ventilation during work.

d. That the chamois mask be considered unsatisfactory for use.

Submitted by:
Steven M. Horvath, Captain, SnC
Arthur Freedman, 1st Lieut., M.C.

6 Incls.
1 - Appendix A - Authority for Project.
2 - Appendix B - Test Data Sheet OQMG-214
3 - Appendix C - Replies to queries in Test Data Sheet OQMG-214
4 - Appendix D - Discussion of Certain Theoretical Considerations
5 - Appendix E - Observations on Protective Value of Clothing.
6 - 4 Figures - Fig. 1 thru 4

APPROVED: Willard Machle
WILLARD MACHLE
Colonel, Medical Corps
Commanding.

C
O
P
Y

Headquarters
ARMY GROUND FORCES
Army War College
Washington, D. C.

420 (23 Jul 1943) GNRQT-10/47635 23 Jul 1943

SUBJECT: Test of Clothing, Battle, Four-Zone.

TO: Commanding General, Armored Command, Fort Knox, Kentucky.

1. It is desired that the Armored Medical Research Laboratory conduct tests on ten (10) suits of the new, four-zone, battle clothing in general accordance with the instructions contained in the attached test data sheet No. OQMG-214, dated 7 July 1943.

2. Upon completion of the test it is desired that test reports in quadruplicate be furnished this Headquarters.

By command of LT. GEN. McNAIR:

/s/ R. J. Delacroix
R. J. DELACROIX
Captain, A.G.D.
Asst. Ground Adj. Gen.

1 Incl.
Test data sheet #214 in dup.
w/14 Inclosures.

400.112/7 (23 July 43) GNOHD 1st Ind. S 20 August 1943

HEADQUARTERS ARMORED COMMAND, Fort Knox, Kentucky, 27 July 1943.

To: Commanding Officer, Armored Medical Research Laboratory, Fort Knox, Kentucky.

For compliance.

By command of Major General GILLEM:

1 Incl: n/c. (dup w/d).

/s/ E. R. Gray Jr
E. R. GRAY, JR.
Major, A. G. D.
Asst. Adjutant General

APPENDIX A

C
O
P
Y

OFFICE OF THE QUARTERMASTER GENERAL

APPENDIX B

TEST DATA

Test No. OQMG-214

Date 7 July 1943

1. Item: (Proper nomenclature Clothing, Battle, 4 Zone from Specification Section) For Description and Suggested Outline of test items included in this test, see attached Inclosures 1 to 13 inclusive. See Inclosure 14 for list of Test Items.

a. Project No. _____ Project approval date _____

b. No. to be tested 10 Outfits Sizes _____

c. Shipped from Research and Development Branch, Military Planning Division, Office of the Quartermaster General.

Date 10 July 1943

2. Item to be used for comparison (use proper nomenclature): Present Standard Issue

a. Specification No. _____

b. No. required _____ Sizes _____

c. Shipped from To be drawn from local supply by the testing agency.

Date

3. S.O.S. or Test Section approval, including date: Letter, Headquarters, A.S.F., 24 May 1943 and Request, Headquarters, A.G.F., Letter 18 May 1943.

4. Test Agencies: Armored Force Medical Research Laboratory, Fort Knox, Ky.

5. Disposition of Items after Test: At the discretion of the testing agency.

6. Dates reports desired: _____

A. Preliminary report _____

B. Interim report _____

C. Final report on or before 1 month from receipt of test items.

7. Basic reason for this project and objective of test:

1. See heading on attached inclosures 1 to 13 inclusive.

8. Suggested outline of test (give details):

Details and questions on the items on which information is desired are listed on attached inclosures 1 to 13 Inclusive.

9. Remarks:

Signatures: Technologist _____

Section Head _____

E. L. HELLER
Major, Q.M.C.,
Test & Review Section

APPENDIX B

TEST ITEM: Jacket, Field, M-1943

BASIC REASON FOR THIS PROJECT AND DESCRIPTION:

To develop a jacket that will replace the standard Jacket, Field, having greater climatic range, greater pocket capacity, flexibility of movement and streamlined design.

1. Jacket is made oversize to allow for use of pile undergarment.
2. Made of wind resistant and water repellent 9 oz. Cotton Sateen.
3. Has new style better fitting collar and neck closure.
4. New high shank large buttons.
5. Fly front.
6. Concealed buttons.
7. Drawstring waist adjustment that can be tied leaving front of jacket open for ventilation.

SUGGESTED OUTLINE OF TEST: Jacket, Field, M-1943.

1. Function

   a. Is there freedom of movement or is it too small when worn with pile undergarment?
   b. Is it too large when worn without pile undergarment?
   c. Is inside drawstring waist closure a good idea?
   d. Is it too short or too long?
   e. Is it preferred to the standard Jacket, Field?
   f. Is it sufficiently windproof and water repellent?
   g. Is adjustable sleeve closure preferred to the open sleeve?
   h. Does it provide adequate warmth when worn over Jacket, Field, Pile?

2. Pockets

   a. Can the cartridge belt be worn? Does it hinder the use of the pocket?
   b. Are the pockets too large or too small?
   c. Is a man handicapped in running, crawling, climbing, or jumping, in the various maneuvers when pockets are loaded?
   d. Is there need for more pockets?

3. Neck Closure

   a. Is the neck closure satisfactory?

TEST ITEM: Jacket, Field, Pile

BASIC REASON FOR THIS PROJECT AND DESCRIPTION:

A basic garment to be worn under the Jacket, Field, Cotton, O. D., to provide adequate warmth in cold climates.

1. Made of 50-50 Mohair and Alpaca, Rayon Facing.
2. Made and designed to be worn as a lounge jacket around barracks.
3. Not intended to be worn out of doors except under Jacket, Field.
4. New high shank large buttons.

SUGGESTED OUTLINE OF TEST: Jacket, Field, Pile.

1. Function

   a. Does rayon facing eliminate possibility of pile creeping?
   b. Can a man function properly when worn under Jacket, Field?
   c. Is it too large or too small when issued in the correct size?
   d. Does it provide adequate warmth when worn under Jacket, Field?
   e. Is the layer concept a good idea?
   f. Do large buttons permit it to be buttoned and unbuttoned with gloves on or when the hands are cold?
   g. Is it liked as a lounge jacket to be worn around the barracks?
   h. Does it provide adequate warmth and comfort?

Inclosure No. 2

APPENDIX B

TEST ITEM: Trousers, Field, Pile

BASIC REASON FOR THIS PROJECT AND DESCRIPTION:

To be worn under Trousers, Field, Cotton, O.D. in the Arctic Zone, combining maximum warmth, minimum weight, freedom of movement.

1. Made of 50-50 Mohair and Alpaca Pile.
2. Drawstring adjustment at leg bottom.
3. Rayon crotch piece to eliminate bulkiness.

SUGGESTED OUTLINE OF TEST: Trousers, Field, Pile.

1. Function

   a. Is draw string adjustment at leg bottom satisfactory?
   b. Is fly satisfactory?
   c. Is there freedom of movement when worn under Trousers, Field, Cotton, O. D.?
   d. Is waist adjustment satisfactory?
   e. Does pile creep?
   f. Are they cut too small or too large when issued in actual waist size?
   g. Should there be a rayon covering as on Jacket, Pile?
   h. Are they preferred to Trousers, Wool, O. D., for this combination?
   i. Do they provide adequate warmth and comfort?
   j. Is rayon crotch piece a good idea?

TEST ITEM: Parka, Field, Cotton, O. D.

BASIC REASON FOR THIS PROJECT AND DESCRIPTION:

A wind-resistant and water-repellent covering for the pile undergarments for wear in the Arctic zone.

1. Made of wind-resistant, water-repellent 9 oz. cotton sateen.
2. Three buttonholes on hood at face opening to button parka into pile liner and hold it in place.
3. New high shank large buttons.
4. Wooden ball on draw string to speed adjustment.

SUGGESTED OUTLINE OF TEST: Parka, Field, Cotton, O. D.

1. Function

   a. Is inside draw string at waist a good idea?
   b. Is wooden ball on draw string adjustments an advantage?
   c. Is it comfortable when worn over Jacket, Pile, and Parka, Pile?
   d. Can the arms be drawn in to the body without difficulty?
   e. Can large buttons be used easily when the hands are cold or when gloves or mittens are worn?
   f. Is the parka too long?
   g. Is it too short?
   h. Is the sleeve cuff adjustment satisfactory?

2. Hood

   a. Is the hood of the proper design?
   b. Does the hood fit various head sizes?
   c. Is a two-way snap adjustment at back of hood a satisfactory means of adjusting the size of the hood?
   d. Is face opening satisfactory?

Inclosure No. 4

APPENDIX B

TEST ITEM: Parka, Field, Pile

BASIC REASON FOR THIS PROJECT AND DESCRIPTION:

A garment to provide adequate warmth when worn over Jacket, Pile, and under Parka, Cotton, O. D.

1. Made of 50-50 alpaca and mohair.
2. Wolverine trim at face opening.

SUGGESTED OUTLINE OF TEST: Parka, Field, Pile.

1. Function

   a. Can the arms be drawn into the body without difficulty?
   b. Is there plenty of freedom of movement when worn with the cotton layers and Jacket, Pile?
   c. Does the pile creep?
   d. Does it provide adequate warmth and comfort?

2. Hood

   a. Is the hood of the proper design?
   b. Is the face opening satisfactory?
   c. Is it satisfactory to have the wolverine trim on the Parka, Pile, or should it be on the cotton shell, O. D.?

Inclosure No. 5
APPENDIX B

TEST ITEM: Parka, Field, Over, White

BASIC REASON FOR THIS PROJECT AND DESCRIPTION:

Designed to serve as a water-repellent, wind-resistant shell to fit over the Parka, Shell, Cotton, O. D., and the Parka, Pile, Lining, in the Arctic regions as a camouflage against a snow background.

1. Made of 6 oz. cotton poplin.
2. Three buttonholes on hood to button into inner layers.
3. New high shank large buttons.
4. Wooden ball on draw string to speed adjustment.

SUGGESTED OUTLINE OF TEST: Parka, Field, Over, White.

1. Function

   a. Is the inside draw string at waist a good idea?
   b. Is wooden ball on draw string adjustments an advantage?
   c. Is it comfortable when worn over Parka, Cotton, O. D., and pile liners?
   d. Can the arms be drawn in to the body without difficulty?
   e. Can large buttons be used easily when the hands are cold or when gloves or mittens are worn?
   f. Is it too long?
   g. Is it too short?
   h. Is the sleeve cuff adjustment satisfactory?

2. Hood

   a. Is the hood of the proper design?
   b. Does the hood fit various head sizes?
   c. Is the two-way snap adjustment at the back of hood a satisfactory means of adjusting the size of hood?
   d. Is the face opening satisfactory?

Inclosure No. 6

APPENDIX B

TEST ITEM: Trousers, Field, Wool, Heavy, O. D.

BASIC REASON FOR THIS PROJECT AND DESCRIPTION:

A heavy wool trouser of 22 oz. Serge to be worn in cold and temperate zones and under Trousers, Field, Cotton, O. D. to provide adequate warmth as required.

1. Made of 22 oz. Wool Serge.
2. New large high shank button, same size throughout.
3. New model with high rise - peg top - fuller front and seat - more accessible button fly.
4. Button and tab closure at leg bottom.
5. Inner loops at waist band for suspenders when trousers are worn under Trousers, Field, Cotton, O. D.

SUGGESTED OUTLINE OF TEST: Trousers, Field, Wool, Heavy, O. D.

1. Function

   a. Is there freedom of movement when worn under Trousers, Field, Cotton, O. D.? Do they provide adequate warmth?
   b. Is the combination of Trousers, Wool, O. D. and Trousers, Field, Cotton, O. D. liked better than the combination of Trousers, Pile, and Trousers, Field, Cotton, O. D.?
   c. Is button and tab closure at leg bottom necessary?
   d. Is peg top fuller cut front and back and higher rise an improvement over the standard model?
   e. Is the rise too high when worn with a belt?
   f. Is the rise satisfactory when worn with suspenders?
   g. Fly is bar-tacked every other buttonhole; does this and the use of larger buttons permit the use of the fly when the hands are cold or gloves are worn?
   h. Is the 22 oz. material too heavy or too light in weight?
   i. Are trousers more comfortable and do they fit better than the standard wool trouser?
   j. Are inner loops at waist band for suspenders necessary when trousers are worn under Trousers, Field, Cotton, O. D.?

TEST ITEM: Trousers, Field, Cotton, O. D.

BASIC REASON FOR THIS PROJECT AND DESCRIPTION:

A new trousers incorporating greater climatic range, greater pocket capacity and exceptionally tough fabric.

1. Made of wind-resistant and water-repellent 9 oz. cotton sateen.
2. Made over-size to allow room for pile undergarments in Arctic zones.
3. New high shank large buttons.

SUGGESTED OUTLINE OF TEST: Trousers, Field, Cotton, O. D.

1. Function

   a. Are trousers too small when worn over pile or wool, O. D. Trousers?
   b. Can a man function properly in this combination?
   c. Are they too large when worn without pile or wool, O. D. Trousers?
   d. Are suspenders necessary in view of large amount of equipment in pockets?
   e. Is new accessible button fly with large buttons an improvement?
   f. Which is more comfortable when worn over pile or wool trousers? Which would be preferred for warmth and comfort?
   g. Is the rise too high?

2. Pockets

   a. Would hip pockets be desirable?
   b. Are front waistband pockets satisfactory?
   c. Will watch pocket be used?

3. Leg Bottom Closure

   a. Is two-way button and tab closure necessary? If so, is it satisfactory?

4. Waistband

   a. Are button and tab waist adjustments sufficient to make trousers fit well when worn without pile or wool Trousers underneath?

Inclosure No. 8

TEST ITEM: Trousers, Field, Over, White

BASIC REASON FOR THIS PROJECT AND DESCRIPTION:

Trousers to be worn as a water-repellent, wind-resistant shell over Trousers, Field, Cotton, and Trousers, Field, Pile, as a camouflage against a snow background.

1. Made of 6 oz. cotton poplin.
2. Openings at side of trousers for access to pockets of inner garments.
3. Draw string adjustment at leg bottoms.
4. One hip pocket.

SUGGESTED OUTLINE OF TEST: Trousers, Field, Over, White

1. Function

   a. Are side openings large enough to permit easy access to pockets of inner garments?
   b. Is draw string adjustment at leg bottom satisfactory?
   c. Is it full enough when worn over Trousers, Field, and Trousers, Pile? Is there freedom of movement?
   d. Is the fly satisfactory?
   e. Is button and draw string waist adjustment satisfactory?

Inclosure No. 9

APPENDIX B

TEST ITEM: Cap, Field, Pile, O.D.

BASIC REASON FOR THIS PROJECT AND DESCRIPTION:

A cap to be worn in cold climates. To provide adequate warmth and protection to ears, neck and throat at time when Parka is not worn.

1. Outer shell 6 oz. Cotton Poplin.
2. Lining of crown wool flannel.
3. Ear flaps and forepiece 50-50 Mohair and Alpaca Pile.
4. Forepiece can be turned down for protection against sun.

SUGGESTED OUTLINE FOR TEST: Cap, Field, Pile, O.D.

1. Function

   a. Do ear flaps provide adequate protection to ears, neck and throat?
   b. Is tie string satisfactory to hold ear flaps in place?
   c. Does forepiece provide adequate sun protection when turned down?
   d. Can the helmet be worn over pile cap when the ear tabs are up or down?
   e. Is the style of the cap well liked?

Inclosure No. 10

APPENDIX B

TEST ITEM: Mask, Field

BASIC REASON FOR THIS PROJECT AND DESCRIPTION:

A face mask of soft pliable chamois leather conformed to fit the face that will overcome the present difficulties of all face masks.

1. Made of chamois leather.
2. Conformed to fit the face.
3. Adjustable head straps.
4. Holes for eyes to be cut out by the individual.

SUGGESTED OUTLINE OF TEST: Mask, Field.

1. Function

   a. Are the adjustable head straps satisfactory?
   b. Does it conform to various shapes and sizes of faces?
   c. Is the nose piece the right size?
   d. Is it satisfactory worn with goggles?
   e. Is it a satisfactory wind break?
   f. Is a mouth piece necessary?
   g. Is it a good idea to let the individual cut out the holes for eyes?

Inclosure No. 11

APPENDIX B

TEST ITEM: Suspenders, Trousers, Roller Action on Front Button Tab ends.

BASIC REASON FOR THIS PROJECT AND DESCRIPTION:

To overcome difficulties of present suspender which does not have freedom of action, falls off the shoulders and pulls off the rear suspender buttons.

1. Roller action at center cross section in back.
2. Rear button tab ends elastic.
3. Roller action on front button tab ends.
4. Cross section in back raised to keep suspenders from falling off shoulders.

SUGGESTED OUTLINE OF TEST: Suspenders, Trousers, Roller Action on Front Button Tab ends.

1. Function

   a. Do suspenders fall off the shoulders?
   b. Is the roller action at the center cross section in back an advantage?
   c. Is the roller action on the front button tab ends an advantage?
   d. Does the roller action give more freedom of movement in bending, twisting, running, climbing, jumping?
   e. Does elastic on rear button tab ends relieve strain on suspender buttons and give more freedom of movement?
   f. Are leather button hole tabs easy to button on to trousers.

NOTE:

Suspenders to be tested wearing Trousers, Field, Cotton, O. D. with Cargo Pockets, Cargo pockets to be filled with weight equivalent to four hand grenades in each pocket and subject to the various maneuvers such as running, jumping, crawling, and climbing.

Inclosure No. 12

APPENDIX B

TEST ITEM: Cap, Field, Cotton, O. D. with Visor

BASIC REASON FOR THIS PROJECT AND DESCRIPTION.

A cap for general year round wear by all Arms and Services.

1. Made of 6 oz. Cotton Poplin.
2. Ear Flaps, wool flannel lined.

SUGGESTED OUTLINE OF TESTS: Cap, Field, Cotton, O. D. with Visor.

1. Function

   a. Can the Helmet be worn over the cap?
   b. Does it provide adequate sun protection?
   c. Is the style of the cap well liked?
   d. Do the ear flaps fit well over the ears and around the back of the neck?
   e. Can it be worn over the wool, cap, knit?
   f. Is there a shrinkage problem after washing?

Inclosure No. 13

APPENDIX B

O. Q. M. G. T-214

CLOTHING, COMBAT 4 ZONE (Experimental)

	ITEM	NUMBER OF EACH
1.	Jacket, Field, M-1943	10
2.	Jacket, Field, Pile	10
3.	Trousers, Field, Pile	10
4.	Parka, Field, Cotton, O. D.	10
5.	Parka, Field, Pile	10
6.	Parka, Field, Over, White	10
7.	Trousers, Field, Wool, Heavy, O. D.	10
8.	Trousers, Field, Cotton, O. D.	10
9.	Trousers, Field, Over, White	10
10.	Cap, Field, Pile, O. D.	10
11.	Mask, Field	10
12.	Suspenders, Trousers, Roller Action on Front Button Tab ends	10
13.	Cap, Field, Cotton, O. D., with Visor	10

Destination:-

Armored Force Medical Research Laboratory
Fort Knox, Kentucky.

Att: Chief Test Officer.

Inclosure No. 14

APPENDIX B

APPENDIX C

JACKET, FIELD, M-1943

1. Function

   a. The jacket is of proper size and does not interfere with freedom of movement when it is worn with the pile undergarment.
   b. It is not too large when worn without the pile undergarment.
   c. The inside drawstring waist closure is a good idea.
   d. The jacket is of proper length.
   e. It is preferred to the standard Jacket, Field.
   f. Its wind-proofing qualities seems to be satisfactory but the test was not specifically designed to examine this point. Water repellancy was not tested for.
   g. The adjustable sleeve closure is preferred.
   h. For discussion of protection against cold, See Appendix B. The cold zone issue is, in general, adequate down to 0°F.

   N.B. The need for shoulder straps is not apparent; when an attempt is made to lift a man by them, they pull loose.

2. Pockets

   a. The cartridge belt can be worn with the jacket, but this makes access to the waist pockets impossible.
   b. The pockets seem to be of proper size.
   c. Loading the pockets does not interfere with activities.
   d. The need for more pockets is not apparent.

3. Neck Closure

   a. Wind seepage at the neck was noted by two (2) subjects. This may have been due to careless adjustment of the flaps of the cap in relation to the jacket collar.

JACKET, FIELD, PILE

1. Function

   a. The rayon facing diminishes but does not eliminate creeping of the pile.
   b. This garment does not interfere with activity when worn under the Jacket, Field.
   c. It is of proper size.
   d. The cold protective value of the cold zone outfit was tested only in its entirety.
   e. The layer concept is desirable.

f. The large buttons constitute an improvement and can be manipulated when gloves are worn.
g. It is possible that the garment might be used as a lounge jacket.
h. See "d." above.

N.B. The new pile was a colder "feel" than previous pile fabrics that we have seen.

TROUSERS, FIELD, PILE

1. Function

a. The drawstring at the leg bottom is satisfactory.
b. The fly is satisfactory.
c. Freedom of movement is not interfered with when these trousers are worn under the Trousers, Field, Cotton, O.D.
d. The waist adjustment seems satisfactory.
e. The pile does not seem to creep on the legs as it does on the arms.
f. The knees are too narrow. The seated subject experiences excessive cooling of the knees on this account. Otherwise the cut is satisfactory.
g. The need for rayon facing is not apparent.
h. There are insufficient data for the expression of a choice between the Trousers, Wool, O.D. and Trousers, Field, Pile.
i. Adequate warmth seems to be provided except for the knees, as indicated above.
j. The rayon crotch piece diminishes bulkiness.

PARKA, FIELD, COTTON, O.D.

1. Function

a. The inside drawstring at the waist is a good idea but it was omitted on several of the garments which we received.
b. The wooden ball and drawstring adjustment is useful.
c. This parka is comfortable when worn as an outer garment.
d. The arms cannot be drawn in to the body without vigorous assistance.
e. The large buttons can be used with reasonable ease when gloves are worn.
f.) The parka is of proper length.
g.)
h. The sleeve cuff adjustment is satisfactory.

N.B. The design of this garment does not allow easy ventilation of the body during activity.

APPENDIX C

2. Hood

a.) The hood is not of proper design. The neck opening is too
b.) small and because of this, assistance is frequently needed for donning and removing the parka.

c.) The face opening is not satisfactory. If the parka hood is
d.) not buttoned to the hood of the Parka, Field, Pile the hoods fail to turn when the face is turned, and vision is greatly interfered with. Buttoning the two hoods together only partly corrects this defect.

PARKA, FIELD, PILE

1. Function

a. The arms cannot be retracted without assistance.
b. This garment does not interfere with freedom of movement.
c. The pile creeps extensively on the arms, the sleeve opening sometimes being found as high as the elbow.
d. Its warmth and comfort are discussed in relation to the entire outfit.

2. Hood

a.) See discussion under Parka, Field, Cotton, O.D.
b.)

c. The wolverine trim on these garments is of very poor quality. The straggling hairs cannot be kept out of the eyes, nose and mouth, and promptly become matted in the region of the chin. We have no basis on which to decide which garment is proper for the application of this fur trim. It is doubtful that the fur trim is necessary.

PARKA, FIELD, OVER, WHITE

The answers to the questions on this garment are the same as given for the Parka, Cotton, Field, O.D.

TROUSERS, FIELD, WOOL, HEAVY, O.D.

1. Function

a. Freedom of movement is satisfactory. The warmth of the cold zone outfit is discussed as an entirety.
b. The tests were not of sufficient duration to examine this point.
c. The button closure at the leg bottom would probably be used when leggings are worn.

d.)
e.) We have no opinion on these points. The knees are too narrow.
f.)

g. The manipulation of the fly is possible when the hands are cold but not when gloves are worn.
h. We have no opinion on this point.
i. The trousers fit comfortably.
j. The need for the inner loops for suspenders at the waist band is not apparent.

TROUSERS, FIELD, COTTON, O.D.

1. Function

a. These trousers are of proper size except that the knees are too narrow.
b. They do not interfere with activity when worn over other trousers.
c. They are not too large when worn alone.
d. The suspenders are probably necessary.
e. The large buttons on the fly are an improvement.
f. Tests have not been run to determine separately a preference for pile or wool trousers at any given temperature.
g. We have no opinion on this point.

2. Pockets

a. We have no opinion on this point.
b. The front waist band pockets are difficult of access.
c. We have no opinion on this point.

3. Leg Bottom Closure

a. The button closure is satisfactory.

4. Waist Band

a. The waist adjustments are satisfactory.

TROUSERS, FIELD, OVER, WHITE

1. Function

a. The side openings are of sufficient size.
b. The drawstring adjustment at the leg bottom seems satisfactory.
c. The trousers do not interfere with freedom of movement.
d. The fly is satisfactory.
e. The waist adjustment is satisfactory.

CAP, FIELD, PILE, O.D.

1. Function

a. The flaps provide adequate protection for the ears, but wind seepage at the neck is not entirely prevented by the neck and throat flaps.

b. The tie string holds the ear flaps in place satisfactorily.
c. We have no opinion on this point.
d. The helmet can be worn over this cap with the flaps either up or down.
e. The style of the cap is well liked.

MASK, FIELD

1. Function

a. The adjustable head straps are satisfactory.
b. Conformity to various shapes of faces seems adequate.
c. The nose piece seems of proper size.
d. The mask was not tested in conjunction with goggles.
e. Until it becomes wet, it seems to be a satisfactory windbreak.
f. We have no opinion on this point.
g. It is probably a good idea to let the individual cut out the holes for his eyes.

N.B. The mask is highly unsatisfactory since it becomes wet and clammy in half an hour and thereby constitutes a potential frosting danger.

SUSPENDERS, TROUSER

1. Function

a.)
b.)
c.) These are satisfactory as far as we are competent to judge.
d.)
e.)
f.)

CAP, FIELD, COTTON, O.D. WITH VISOR

Not received for test.

BOOTEE, FELT AND SHOE, FELT, ALCAN

Comparison of these items gives no clear cut evidence for preference for either one although the general impression is that the Alcan shoe is slightly superior. It has the added advantage of offering more stability for the foot, when worn inside either the shoe pac or the mukluk.

UNDERWEAR, WOOL

Most of the subjects, having worn the six piece arctic suit during their previous period of residence in the cold chamber at -20°F, expressed a preference for pile next to the skin instead of woolen underwear. Previous reports have stressed the loss of shape and shrinkage of wool underwear with laundering. Dermatitis has been noted as a consequence of wearing the pile next to the skin.

APPENDIX D

1. General Procedure

The experiments were conducted in the cold room under the following conditions of temperature and wind velocity:

TABLE I

Day	T°F	Wind
1	+20	3-12 mph for 5 min. of each hour
2	0	3-12 mph for 5 min. of each hour
3	0	3-12 mph for 5 min. of each hour
4	-18	3-12 mph continuously
5	-40	3-12 mph continuously
6	- 8	None

An M5 light tank was brought into the cold room prior to the experiment, in order that some of the subjects might be seated in it. An automatic temperature recording device indicated that all parts of the tank were in approximate thermal equilibrium with the air in the cold chamber before and during each test. An auxiliary ventilating system for drawing air through the buttoned-up tank was provided for the purpose of simulating the conditions of air movement in the crew compartment of the tank while in motion. Approximately 1500 cubic feet of air per minute was drawn through the tank, roughly equivalent to the ventilating rate with an engine speed of 1400 r.p.m. or a cruising speed of 13 mph in high gear. The air discharged from this system directly into the cold chamber and produced a constant low grade turbulent wind, over and above that created by the refrigerator fans.

Ten volunteer subjects, who had been accustomed to the cold room, during a period of eight days residence in it at -20°F a week previously, were used as subjects.

The subjects wore the Cold Zone issue on the first two days of the experiment and the Arctic Issue on the last four days. Five of them dressed in a small observation room (within the cold chamber) at approximately +40°F, and five dressed in the adjoining laboratory at +75°F. Those who dressed in the observation chamber kept their clothing in the cold chamber to avoid moisture adsorption which occurs in cold garments exposed to humid atmospheres. Six of the ten subjects wore thermocouple harnesses, each harness having five couples. Skin temperatures were usually obtained on the right and left great toes, thigh, chest, and arm or knee. No attempt was made to measure finger temperatures, since direct observation alone clearly indicated the inadequacy of the hand gear.

After dressing, six of the men, carrying 20 pound packs, walked at the standard army pace of 2.5 mph inside the chamber for 50 minutes. Two others walked for 50 minutes without pack, on the treadmill at 3 mph on a 3% grade. At the end of the first hour, two of the six men who walked around

the room, and the two who walked on the treadmill took their seats in the tank. The other four men sat on wooden stools in the cold room proper, less than three feet from the tank, since not much more clearance than this existed between the tank and the chamber wall. At the time that these eight men were seated, the remaining two subjects entered the chamber and began walking on the treadmill. These walks before the sitting period had as their purpose an approximation of the activity of readying a tank before starting on a run. They also served to provide comparable states of exposure and activity for all of the subjects prior to the sitting phase of the test.

During the period of sitting, the men were permitted such activity as reading, tapping the feet, and twisting in their seats. The activity attendant upon the insertion of rectal thermometers must also be taken into account; this is not inconsiderable when the subject is wearing several layers of clothing. On the first three days of the experiment, a hot lunch was served to the men while they were seated in the chamber. The men were permitted to get up from their seats to void, if necessary.

2. Artificiality of Test Conditions

It is well to point out the lack of similarity between the environmental conditions in the cold chamber and actual field conditions, especially with respect to the use of subjective sense of comfort, and the skin and body temperatures as indices of the adequacy of clothing. In the cold chamber there is no possibility of heat gain from solar radiation nor from the reflection of it from snow--an important item in the comfort of individuals out-of-doors in the north. Introducing a tank into the cold room, although providing additional surfaces to which to radiate, may not, however, create a greatly different situation than that of the cold chamber without the tank. Further, the lack of snow in the cold room eliminates whatever discomfort may ensue when it melts on clothing.

Men in tanks and vehicles are constantly being jostled while the vehicle is in motion. This form of activity, which is not reproducible in the cold chamber, may play an appreciable role in maintaining body warmth. To what extent the repeated contact with the cold metal of the tank counterbalances this, cannot be estimated.

Finally, a constant temperature was maintained throughout a given day. The maintenance of this temperature was achieved by the operation of the circulating fans in the refrigeration system at irregular intervals. These fans, in turn, determined the amount of wind in the cold chamber. No experiments have been run in this Laboratory for the purpose of studying the relative influence of different wind speeds upon the behavior of clothing.

The substance of these observations is this: that the avenues of heat loss (radiation, conduction, convection, evaporation) through the clothing as tested in the cold chamber, are not entirely like those which determine the heat loss of the wearer during actual field use. As a consequence, although it is possible to compare one outfit with another, one may

not with certainty draw final conclusions concerning the actual adequacy or inadequacy of clothing. These final conclusions can come only from field use.

3. Type of Data Collected

Skin temperatures of the subjects wearing the thermocouples were recorded at the beginning, middle, and end of the walking period, and three or four times an hour during the sitting period. Rectal temperatures were obtained before the experiment, after the walk, and at half hourly to hourly intervals during the sitting period. In addition, the men were weighed in the cold chamber before and after the experiment, with and without clothes. The weight data were too equivocal to be utilized in the evaluation of clothing. Lastly, subjective sensations of each of the men were recorded for every part of the body affected, at frequent intervals, in terms of the following symptoms: "too warm, comfortable, chilly or cool, cold, cold with slight pain, cold with severe pain, tingling, numbness, and shivering."

4. Discussion

Examination of the records of subjective symptoms of cold reveals that there is only partial correlation with skin temperatures. Two examples are illustrative; (1) at 0°F, when wearing the cold zone issue with shoe pac, the subject remained in the cold chamber for 2½ hours, although for two of these hours his toes as well as his knees felt extremely cold; during this time the recorded toe temperatures never dropped below 45° and the knee temperatures ranged around 66°F. On the other hand, at 0°F wearing the arctic zone issue and mukluks, the toe temperatures were much the same but the toes did not feel nearly as cold as in the first experiment. During this arctic issue test, the fingers suffered more than the toes. This may be partly due to observation that a subject seems to be acutely aware of only one cold area at a time. (2) During the course of previous experiments in which men maintained residence in the cold room at -20°F for a week or more, they felt colder on some days than on others, although the temperature of the cold room was maintained with great constancy. The cause for this fluctuation in sensory perception is not clear. As noted above, sense of coldness does not correlate closely with differences in skin temperature levels. At ambient termperatures down to -20°F, the toe temperatures reach equilibrium levels ranging between 45° and 55°F. Sensations of cold with pain on the other hand appear before the equilibrium levels are reached. This has resulted in our tests being terminated not because of further drop in toe temperature to dangerous levels, but because of intolerable sensation of cold.

Although the evidence for complete harmony between subjective sensations and toe skin temperatures is not very convincing (Fig. 3), sensations of coldness or coldness with pain appear frequently when the toe temperature reaches 55°F. This is especially evident at environmental temperatures below 0°F. Our information for temperatures above 0°F is too meager to permit drawing conclusions but considerably greater discrepancies between subjective sensations and toe temperatures have been observed. More data is required to determine the degree of correlation between sensation and skin temperatures.

Shivering of any degree is an imperfect criterion of the effectiveness of clothing since it apparently can be induced by minor cooling of a small area of the body. Although shivering is a mechanism for increasing the generation of body heat, it is psychologically distressing, as well as being productive of physical fatigue.

5. Addendum:

In the course of other experiments in the Laboratory, men wearing the 6-piece Arctic Zone clothing issue have lived with reasonable comfort in the cold room for fifteen (15) days and nights at -20°F with intermittent winds up to 12 mph. Their day's routine consisted of period of walking with packs at standard army pace, of periods of heavier work, and of one period of quiet sitting for two hours and another quiet period of 40 minutes. Nights were spent in sleeping bags, separated from the concrete floor by one army mattress. Occasional changes of socks and gloves were allowed. The sleeping bags were taken outside to dry in the sun each day, but all other gear remained in the cold chamber. Hot meals were served three times a day. Some escape from the cold was permitted into a small wooden hut in the cold chamber (warmed to approximately +30°F) to which the men could retire for about a half hour at noon, and for as long as they desired after the evening meal, before crawling into their sleeping bags. At the termination of the experiments no untoward effects occurred and no frostbite developed during their course. It is apparent, therefore, that men can live at -20°F in the 6-piece arctic issue in reasonable comfort and without danger of freezing. This type of experiment has not been conducted with the new arctic zone issue.

APPENDIX E

The composition of each of the outfits under test was as follows:
(Clothing, Combat, Four-Zone (Experimental)

Cold Zone

Undershirt, wool
Drawers, wool
Trousers, field, wool, heavy, O.D.
Trousers, field, cotton, O.D.
Sweater, wool, high neck
Jacket, field, pile
Jacket, field, M-1943
Cap, field, pile, O.D.
Suspenders, trousers
Socks, cushion sole (one pair)
Socks, ski (one pair)
Shoe pac
or
Shoe, felt, (Alcan)
Mittens, wool, trigger finger
Mittens, shell, trigger finger

Arctic Zone

Undershirt, wool
Drawers, wool
Trousers, field, pile
Trousers, field, cotton, O.D.
Sweater, wool, high neck
Jacket, field, pile
Parka, field, pile
Parka, field, cotton, O.D.
Cap, field, pile, O.D.
Mask, field
Suspenders, trousers
Socks, cushion sole (one pair)
Socks, ski (one pair)
Shoe, felt, (Alcan)
or
Bootee, felt
Mukluks
*Mitten, wool, trigger finger
Mitten, shell, trigger finger

---

* Two pairs of these were worn in the experiment at -40°F.

The following table is a summary of the length of time the subjects sat either in the tank or in the chamber proper and indicates the relationship between the environment and clothing worn.

TABLE II *

Day	Temp.	Wind	Clothing	Duration of Experiment
1	-20°F	3-12 mph 5 min. of each hour	Cold Zone	5¼ hours
2	0	3-12 mph 5 min. of each hour	Cold Zone	2 to 3 hours
3	0	3-12 mph 5 min. of each hour	Arctic Zone	4½ hours
4	-18	3-12 mph continuously	Arctic Zone	1½ hours
5	-40	3-12 mph continuously	Arctic Zone	½ to 1¼ hours
6	- 8	None	Arctic Zone	2½ hours

Under these conditions the incomplete protection provided by the Cold Zone and Arctic Zone outfits resulted in the following:

1. Excessive cooling of the hands and feet
2. Excessive cooling of the knees
3. Difficulty of adjusting body ventilation

The termination of each test was almost invariably due to excessive cooling of the extremities, except on the first day at -20°F, when the subjects were still reasonably comfortable after 5¼ hours exposure.

In a previous report from this laboratory - "The Adequacy of Armored Force Winter Clothing", Project Nos. 1-1, 1-4, 1-5, 1-6, dated January 18, 1943, criteria of adequacy of clothing were set up. It is believed that clothing should protect the trunk to the extent that the skin temperature of the torso and of the extremities will not fall below 85°F and 55°F respectively. These limiting temperatures were used in evaluation of the issues under test. Since men will not endure severe cold with suffering even if it means sacrificing duty, the subjective sensations were also used to evaluate the adequacy of the clothing.

Both the cold and arctic zone issues have been found to keep the skin temperature of the torso well above 85° under every condition tested. Thigh temperatures dropped slightly below this level but without distress on the part of the subjects. The lower temperatures observed in the latter area are probably the result of the poorer insulation over the legs as compared with that for the torso.

* In addition to the 3-12 mile per hour wind from the fan of the refrigeration system, turbulent air currents arose from the air being pulled through the tank. On the first three days a hot lunch was served in the cold chamber at the end of the third hour of the sitting period. The size of the tank restricted the subject's activity to such minor movements as tapping the feet; equivalent freedom of movement was therefore permitted the subjects seated in the cold room.

Toe temperatures were maintained even less successfully. The ranges of toe temperatures for one subject with ambient air temperatures from +20°F to -40°F are shown in Table III. The cold zone issue with shoe pac maintained this subject's toe temperature above 55°F for one and a half hours at a room temperature of +20°F but for less than an hour at 0°F. The arctic issue was effective for more than one hour down to -18°F, but the toe temperatures were never as high as 55°F when the ambient was -40°F.

Figs. 1 and 2 show, for each of the six days of the test, the skin temperature of the right great toes of two subjects, one sitting inside (Fig. 1), and the other sitting outside the tank (Fig. 2). It is to be noted that when the cold zone issue was worn there were decided differences in toe temperatures with ambient temperatures of +20° and 0°F although comfortable temperatures of the torso were recorded in both tests. With the ambient temperature at +20°F, the toe temperatures leveled off in the neighborhood of +55°F and remained at this level for the duration of the experiment (over 5 hours). At a room temperature of 0°F, however, the toe temperatures dropped steadily, reaching 50°F within a period of 2 hours.

Since an ambient temperature of 0°F appeared to be the lower limit at which the cold zone issue offered adequate protection, the test was repeated at 0°F with the subjects wearing the arctic zone issue. While no appreciable differences were observed in torso temperatures, there was considerable improvement with respect to the time during which comfortable toe temperatures were maintained. The subjects were able to sit for at least one additional hour before the cooling of extremities caused an equivalent degree of discomfort. The relative improvement in toe temperatures with the arctic issue at 0°F is shown for two subjects in Fig. 4. In the case of Subject B.D., starting with identical toe temperatures at the end of a standard walk, the temperature fell more rapidly during the resting period when the cold zone clothing was worn and reached 55°F in 2 hours whereas, with the arctic zone clothing, this temperature was not attained until nearly 4 hours had elapsed. The differences were more striking with the second subject (A.B.) since, with the cold zone clothing he was not even able to maintain his toe temperature during the walking period and it was below 55°F practically from the start of the sitting period. Further tests are planned to determine whether the improvement in foot protection with the arctic issue resulted from the additional insulation provided for the feet or from that given by the superior body clothing.

Protection for the knees was inadequate for three of the four men in the tank when the cold zone clothing was worn at +20°F, and for all four at 0°F. Considerable pain was experienced by one subject whose knee temperature reached 57.2°F; after the first hour this man felt obliged to stand up for relief at 10-minute intervals, and found it necessary to come out of the cold chamber after 2 hours of sitting in the tank. Despite the fact that the recorded skin temperatures at the knees were as low when the men wore the arctic issue, they complained very little on this account—perhaps because the hands and feet demanded greater attention. This is a further example of the lack of correlation between skin temperature levels and sensation.

In the experiments conducted at -18°F and -40°F it was necessary to operate one fan (approximate turbulent velocity 3-12 miles per hour) continuously over the cooling coils in order to maintain the tank and room in thermal equilibrium. This made the test conditions more severe for the men sitting in the room, without greatly altering the conditions for the men in the tank. At -18°F the men were able to tolerate the cold for approximately 1½ hours, while at -40°F this time was reduced to ½ hour for four, and 1¼ hours for the others. Since no appreciable difference was detected between the two groups it may be surmised that the heat lost by the men in the tank through radiation and conduction was equivalent to that lost by the men outside as a result of increased convection losses. At both environmental temperatures the excessive cooling of the extremities proved to be the limiting factor. In one of our subjects a toe temperature of 1.6°C or 35°F was recorded at the end of a half hour. No ill effects were observed though this temperature was maintained for fifteen minutes.

For a given combination of protective clothing, the toe temperature decreases with time according to the relationship

$$T = A + B e^{-kt}$$

where T = toe temperature above ambient temperature
k = constant, function of overall conductance and heat capacity of cooling body
A & B = constants

If the rate of heat input remains constant, it can be shown that

$A = T_e$ = equilibrium toe temperature above ambient temperature
$B = T_o - T_e$, where T_o = initial toe temperature above ambient temperature

The equation shows that as the ambient temperature is decreased the final equilibrium toe temper ature will also decrease. It is, of course, independent of the toe temperature at the start of the sitting period. The percentage range of cooling, however, will be constant, only if the rate of heat input and the overall conductance of the insulating barrier remain constant throughout the resting period. The toe temperature attained at the end of the standard one (1) hour walk, will depend upon the ambient temperature, the toe temperature at the beginning of the walking period, and the protective value of the clothing. Temperature changes in general agreement with the foregoing were noted in the cold room test, as shown in Fig. 2. Thus, the toe temperatures at the end of the walking period varied with ambient temperature and clothing, as follows:

Ambient Temperature	Clothing	Toe Temperature at end of walk
+20°F	Cold Zone	88°F
0	"	64
0	Arctic Zone	74
- 8	"	67
-18	"	59
-40	"	52

The subsequent drop in temperature during the sitting period also followed in a general way the relationship indicated by the equation, with evidence of final equilibrium temperature varying with ambient temperature. It is interesting to

note that as the latter drops, the elevation of the equilibrium temperature above ambient increases; thus, for room temperature of 0°, the equilibrium temperature is approximately 40°, whereas, with an ambient of -40°, the equilibrium temperature is above 30°, that is 70° above the room temperature. This suggests that the rate of heat input into the toe increases with decreasing ambient temperature.

Experiments conducted with the two cold weather clothing issues during work requiring four to six times the basal energy requirements, showed that the cold zone issue protects men well when working at 0°F. Studies to determine the minimum temperature at which the cold zone issue will protect during work have not been completed. The arctic issue is more than adequate for work at -40°F with wind, provided the nose is protected. One subject who walked on the treadmill for two hours at -40°F had shed his pile jacket, pile parka, and O.D. parka after the first hour. His rate of cooling after the longer walking period was not appreciably different from that of the subjects who walked on the treadmill for only one hour.

Conclusions:

Under the conditions of test, the foot and hand gear with both the cold zone and arctic issues have been found inadequate. The knee protection afforded by the cold zone issue has also been found inadequate. The body clothing, on the other hand, appeared to be more than adequate. These conclusions are arrived at because (1) practically every day's test was terminated due to complaints of painfully cold extremities, and (2) only on one day was complaint received of chilliness of the torso, that occurring when wind seeped down the neck of two subjects wearing the cold zone issue (in this instance there is no assurance that the collars were properly fastened).

For practical purposes the Armored Command has available in the Cold Zone Clothing Outfit, garments for the torso that are superior to the Outfit, Combat, Winter. The foot and hand gear offer much less protection than does the body clothing, and it is these items which require urgent attention at present. Further development of protective gear of higher insulating value is recommended.

In Appendix C some modifications of garment design are suggested. These do not greatly affect the overall utility of the clothing.

TABLE III

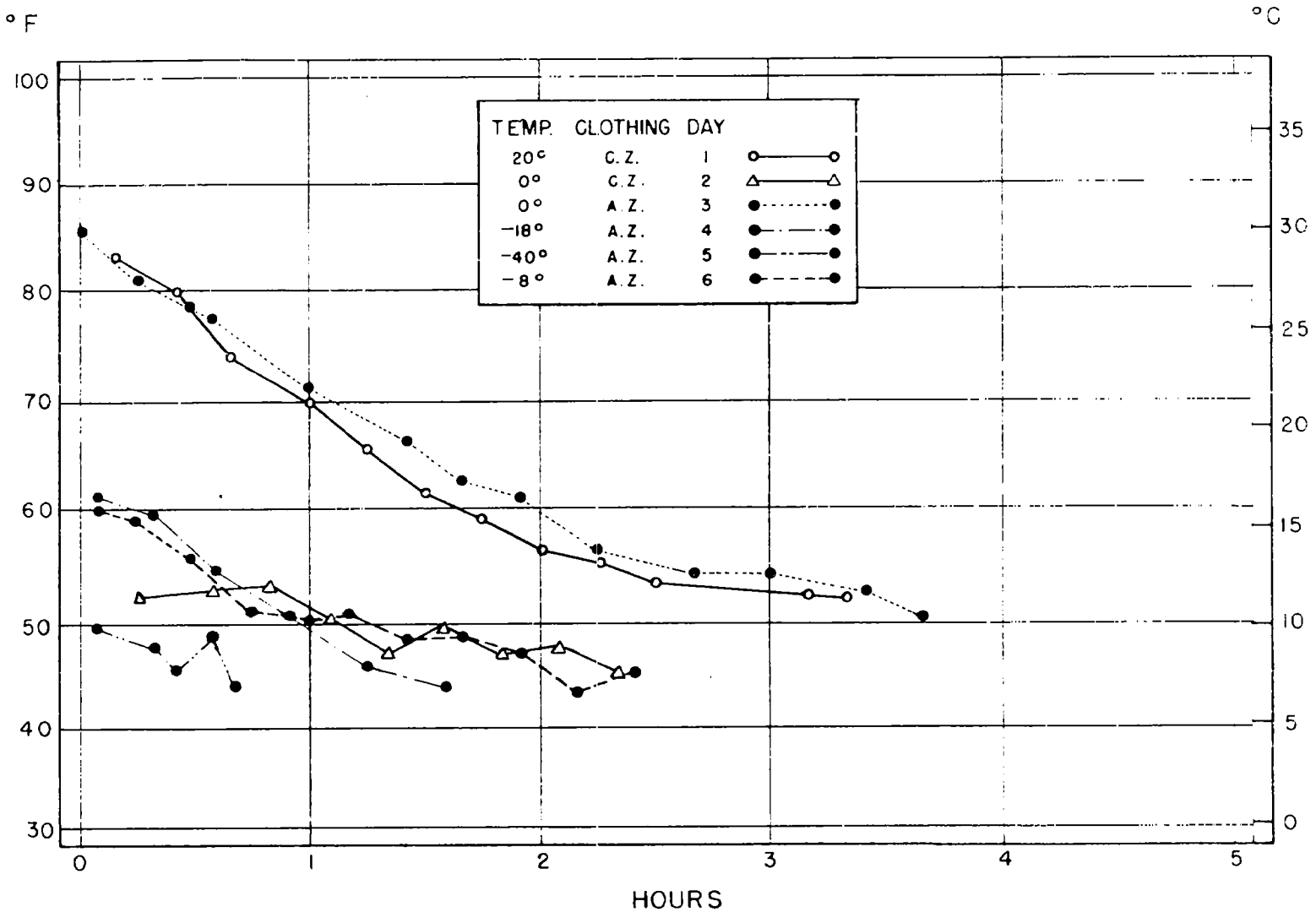
RELATION OF TOE TEMPERATURE TO LIMIT OF TOLERANCE TO COLD

(Subject J. F.)

Temp. & Wind	Clothing	Toe Temperature On Treadmill	Time to drop to 55°F	Range of Toe Temp. End of Test*	Time between Attainment of 55°F Toe Temp. and End of Test
+20°F - 3-12 mph 5 min./Hr.	Cold Zone Shoe Pac	95° - 96°	1½ hours	50° to 55°	3 hours
0°F - 3-12 mph 5 min./Hr.	"	60° - 73°	1 hour	45° to 55°	2½ hours
0°F - 3-12 mph 5 min./Hr.	Arctic Zone	68° - 70°	1¼ hours	45° to 55°	2½ hours
-18°F - 3-12 mph Continuously	"	68° - 82°	1 hour	48° to 51°	½ hour
-40°F - 3-12 mph Continuously	"	45° - 50°	0	35° to 41°	½ hour
- 8°F	"	72° - 75°	1½ hour	46° to 51°	3/4 hour

* Test terminated because of cold of intolerable degree in either the hands, feet or knees.

APPENDIX E



SKIN TEMPERATURE OF RIGHT GREAT TOE
WHILE SITTING IN TANK AFTER STANDARD WALK
(SUBJECT A.B.)

FIG. 1

FIG. 1

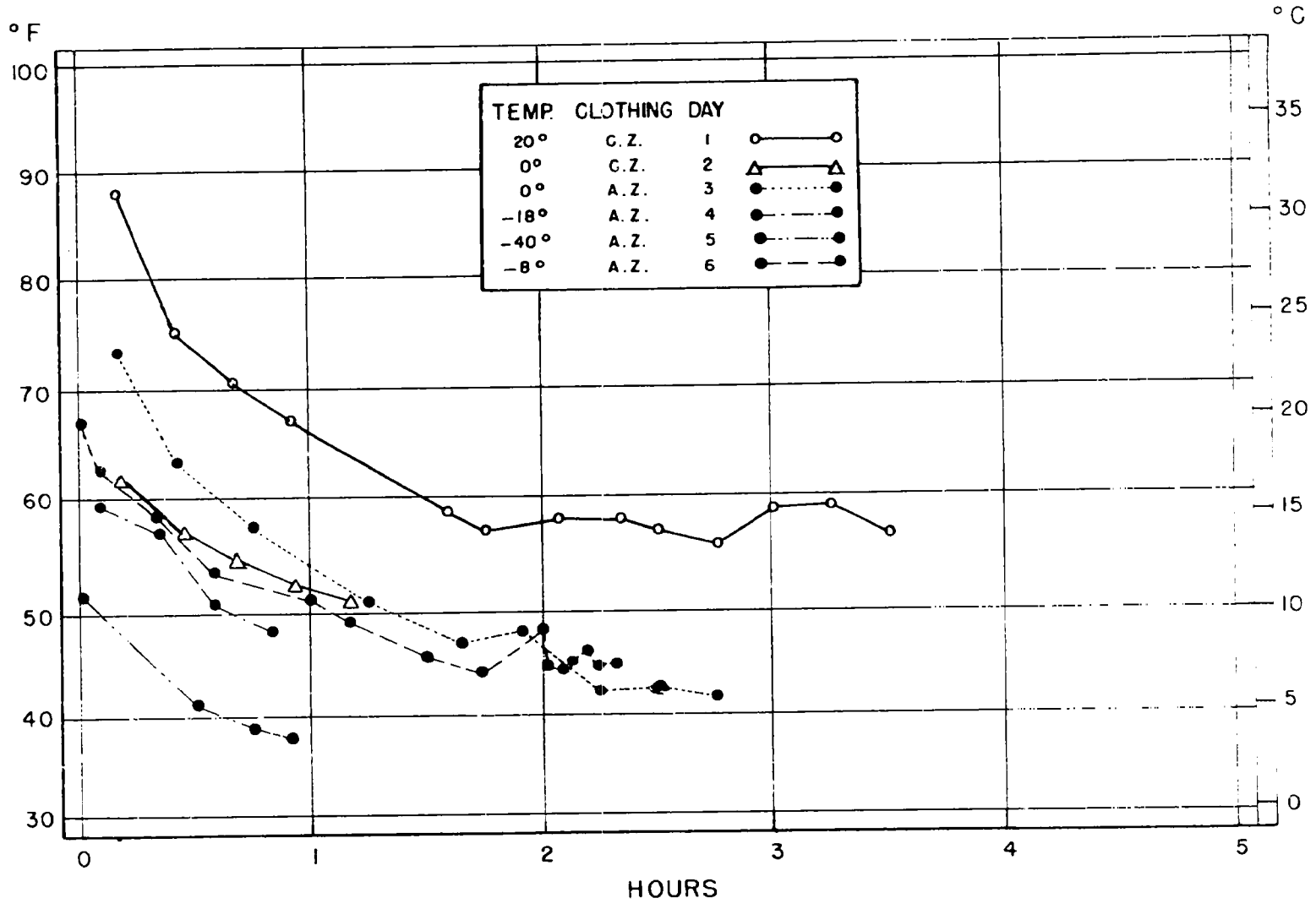


FIG. 2

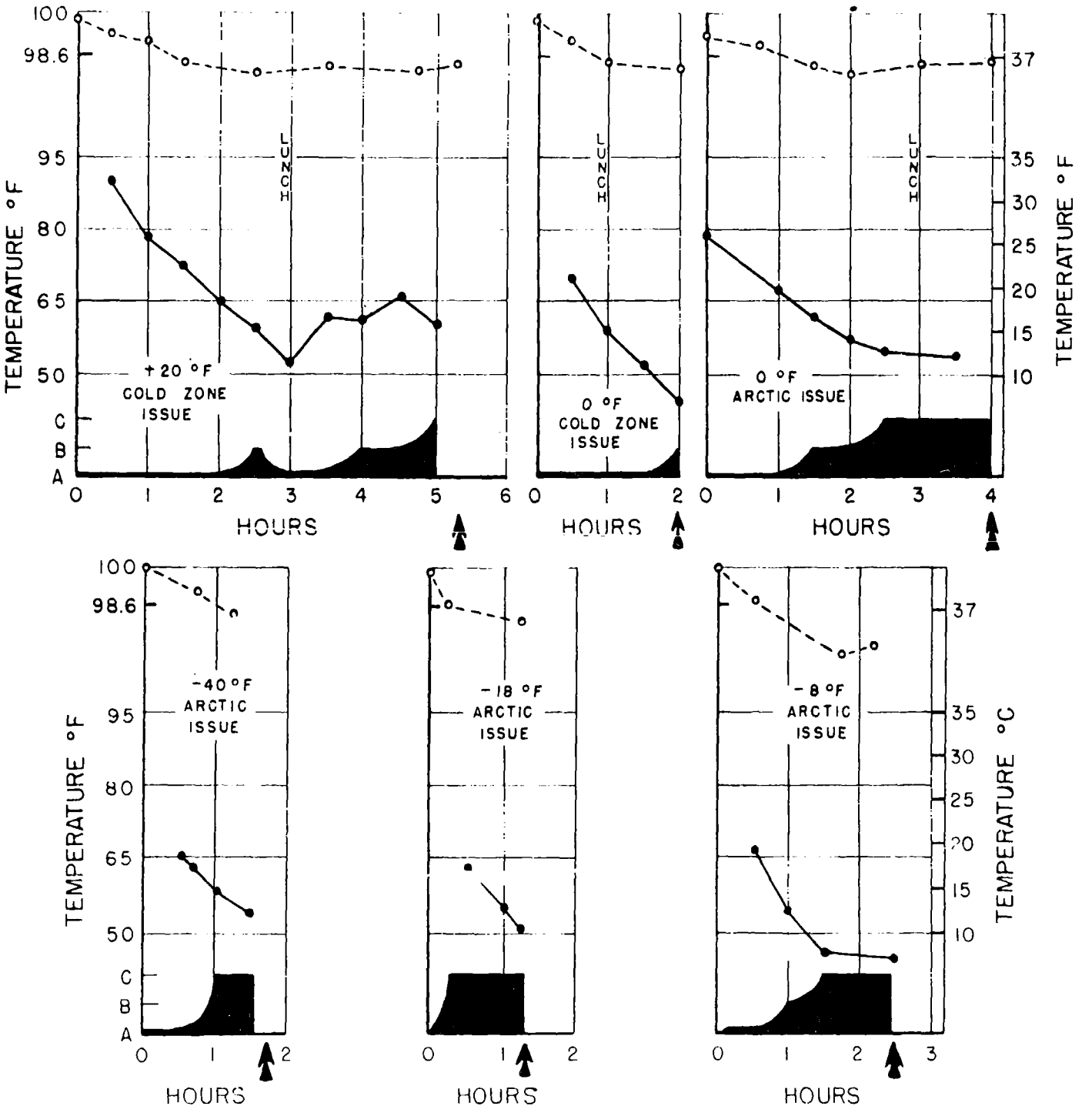
SKIN TEMPERATURE OF RIGHT GREAT TOE
WHILE SITTING IN COLD ROOM AFTER STANDARD WALK
(SUBJECT R. R.)

FIG. 2

FIG. 3

COMPARISON OF RECTAL AND TOE TEMPERATURES AND TOE SENSATIONS FOR EACH DAY OF TEST

SUBJECT B. D.



o---o RECTAL TEMPERATURE

TOE TEMPERATURE

EMERGENCE FROM COLD CHAMBER

TOE SENSATIONS

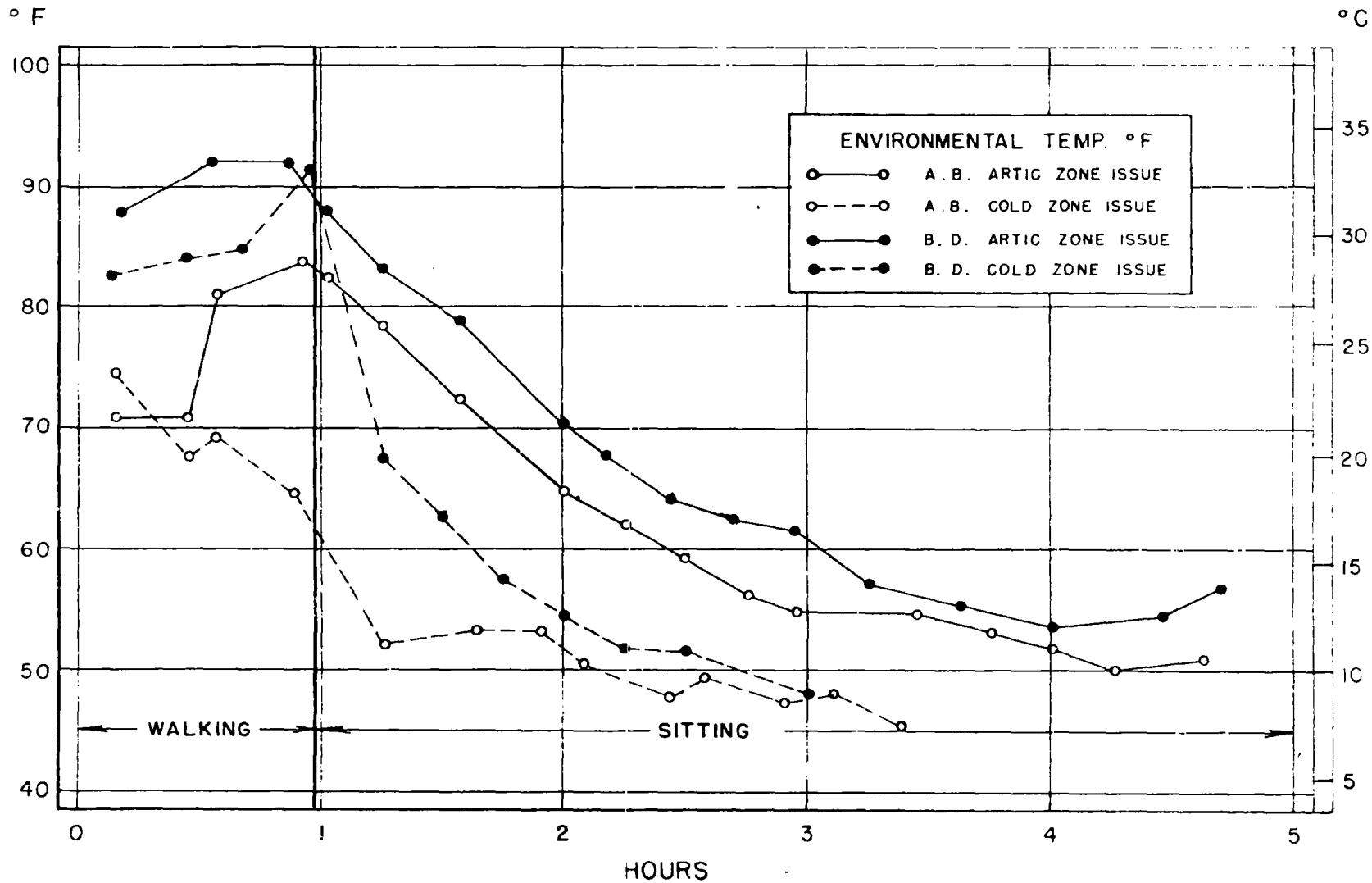
SCALE - A = COMFORTABLE
B = COLD
C = COLD WITH PAIN

AIR FLOW THROUGH THE TANK = 1500 C F M

Incl #6

FIG. 3

NOTE ENLARGEMENT OF SCALE FOR RECTAL TEMPERATURE



SKIN TEMPERATURE OF GREAT TOE DURING STANDARD WALKING AND SITTING PERIODS

FIG. 4

FIG. 4